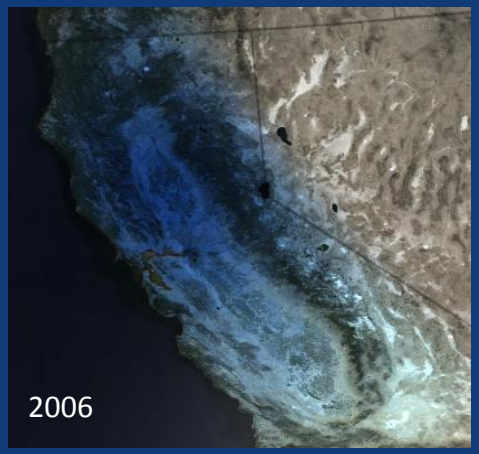
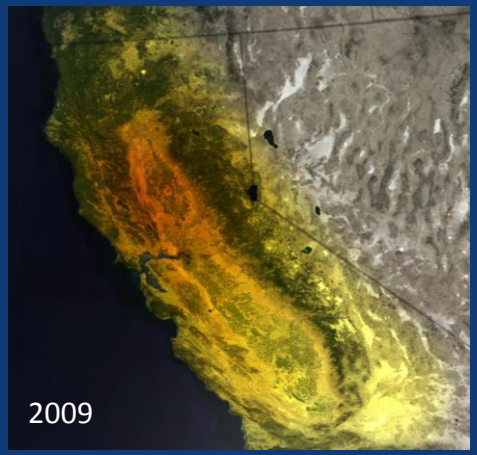
Jay Famiglietti

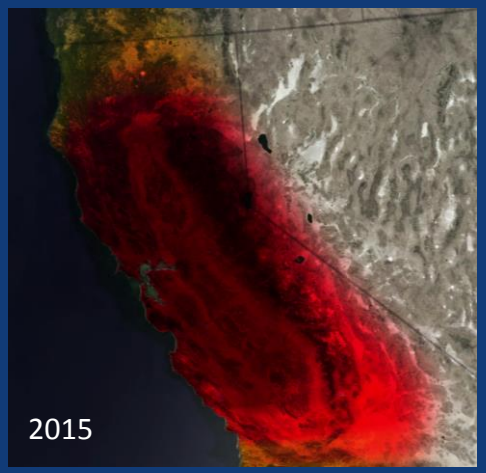
Senior Water Scientist
California Institute of Technology
Jet Propulsion Laboratory

Board Member, LARWQCB (Region 4)

Observing Hydrology and Climate Change from Space







Water Quality Coordinating Committee
California State Water Resources Control Board
Sacramento, October 25, 2017

Questions:

Can we use NASA satellite and airborne data and other expertise to address climate change?

Can we help the SWRCB and the regional boards?

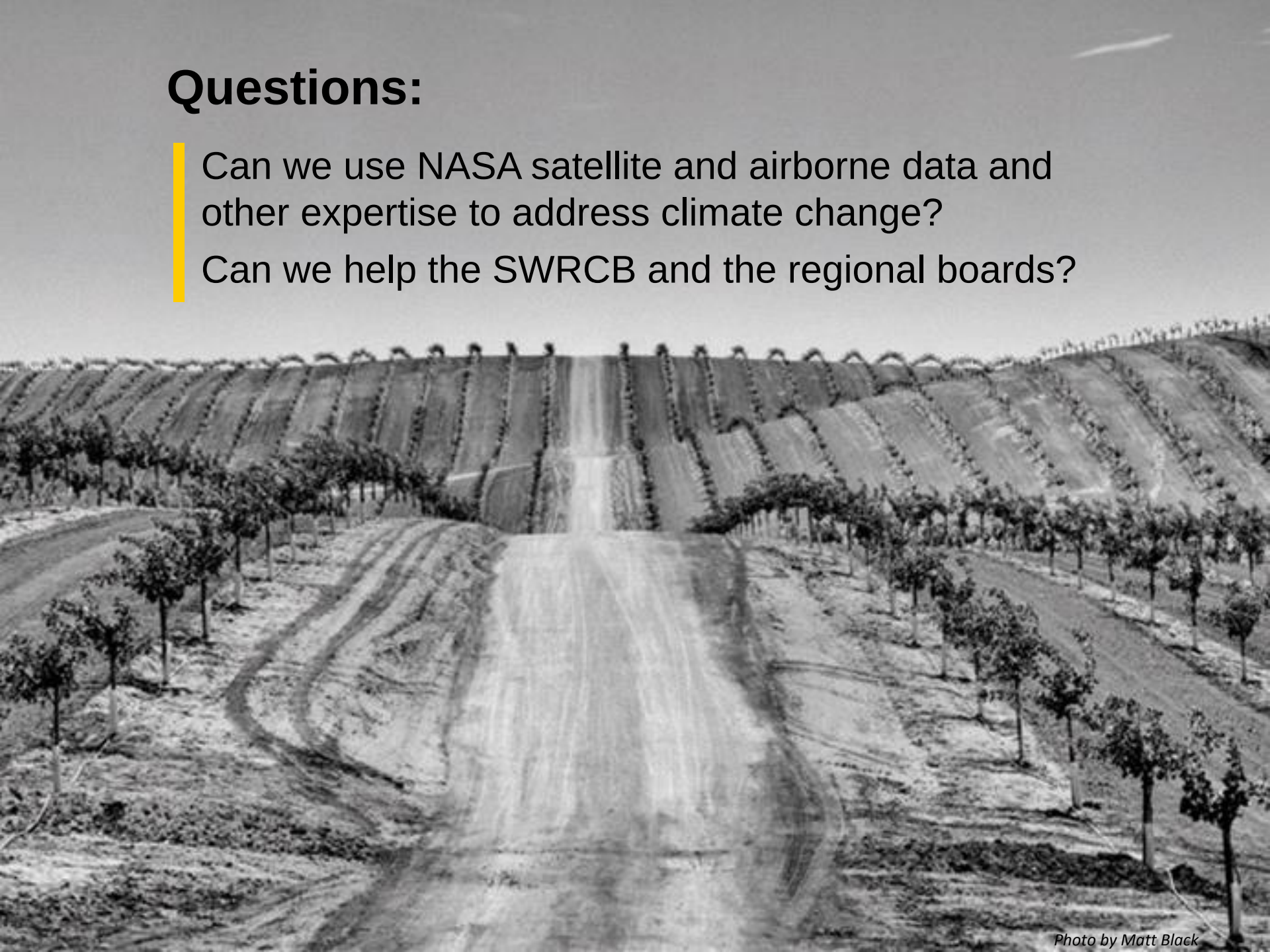
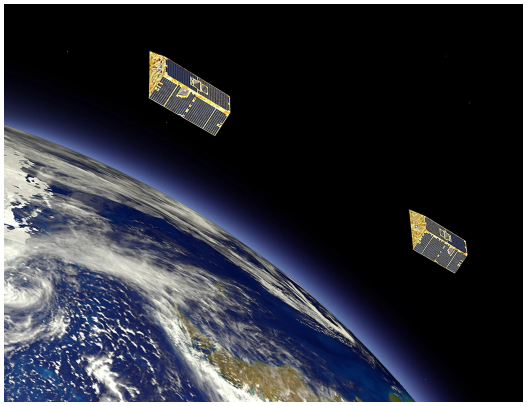


Photo by Matt Black

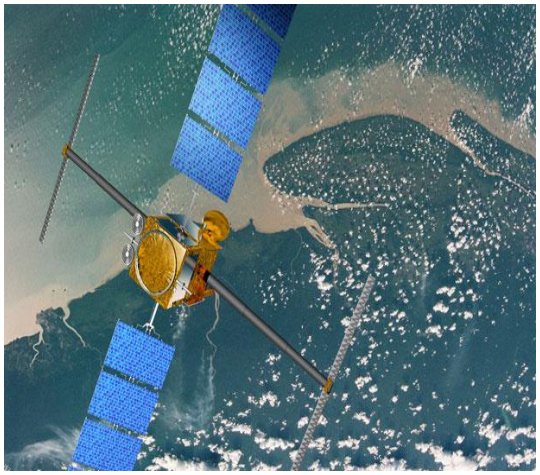
Some Current and Future NASA JPL Satellite and Aircraft Water Missions

GRACE (2002-2017)
GRACE-FO (2018)

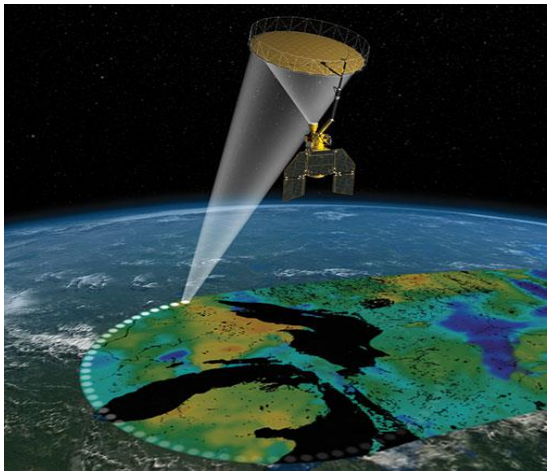


ASO (2013)

SWOT (2021)



SMAP (2015)

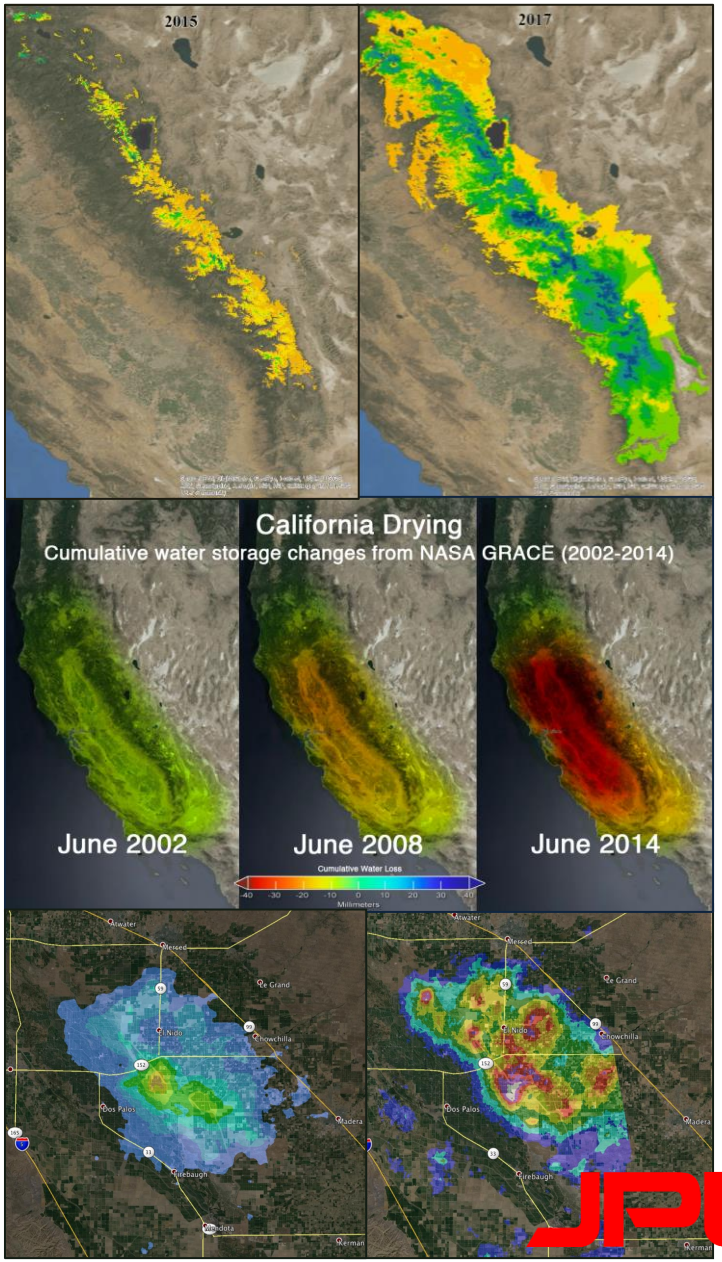


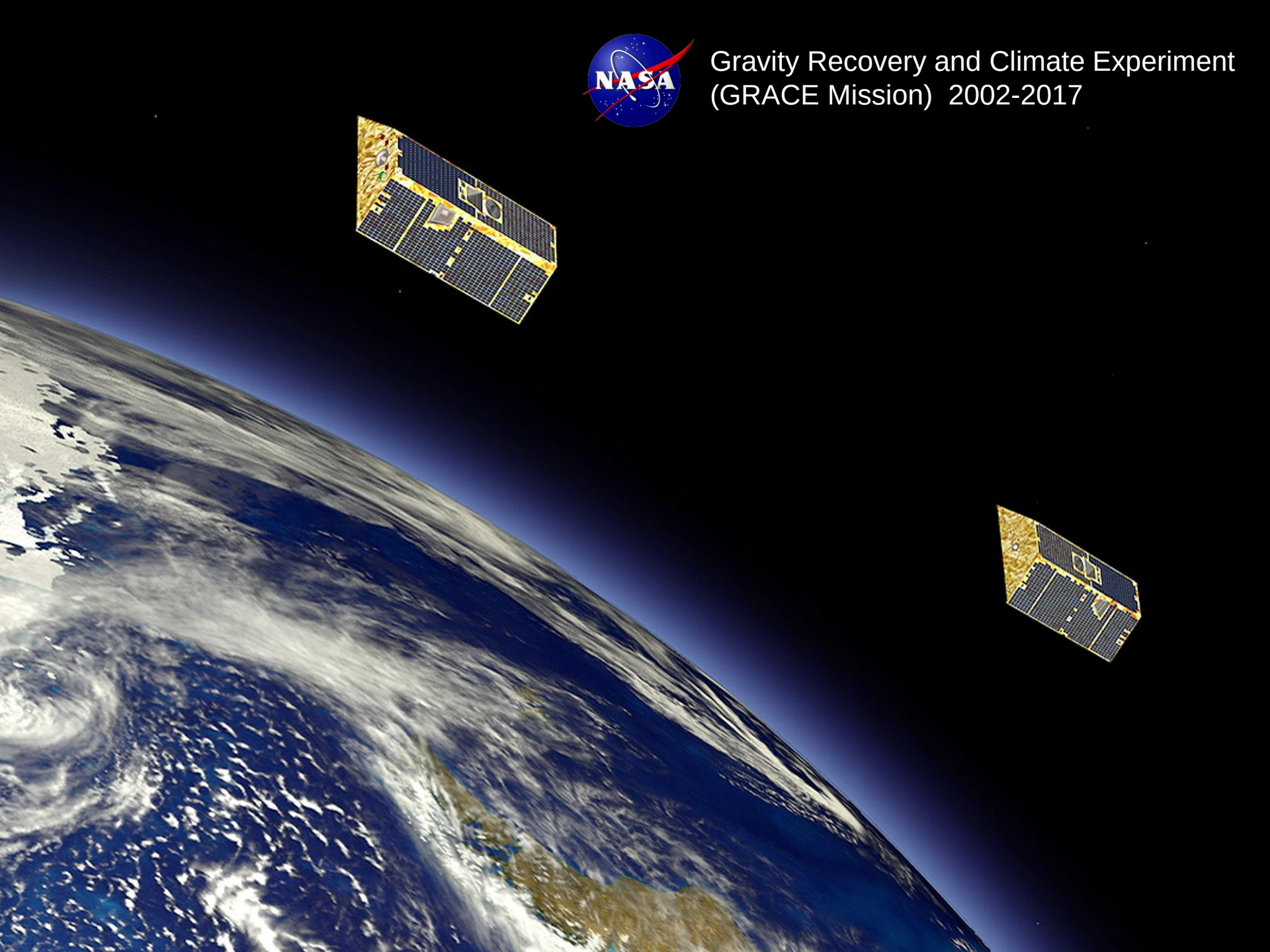
Plus NISAR, GPS, etc

Potential Utility of NASA Airborne and Satellite Assets

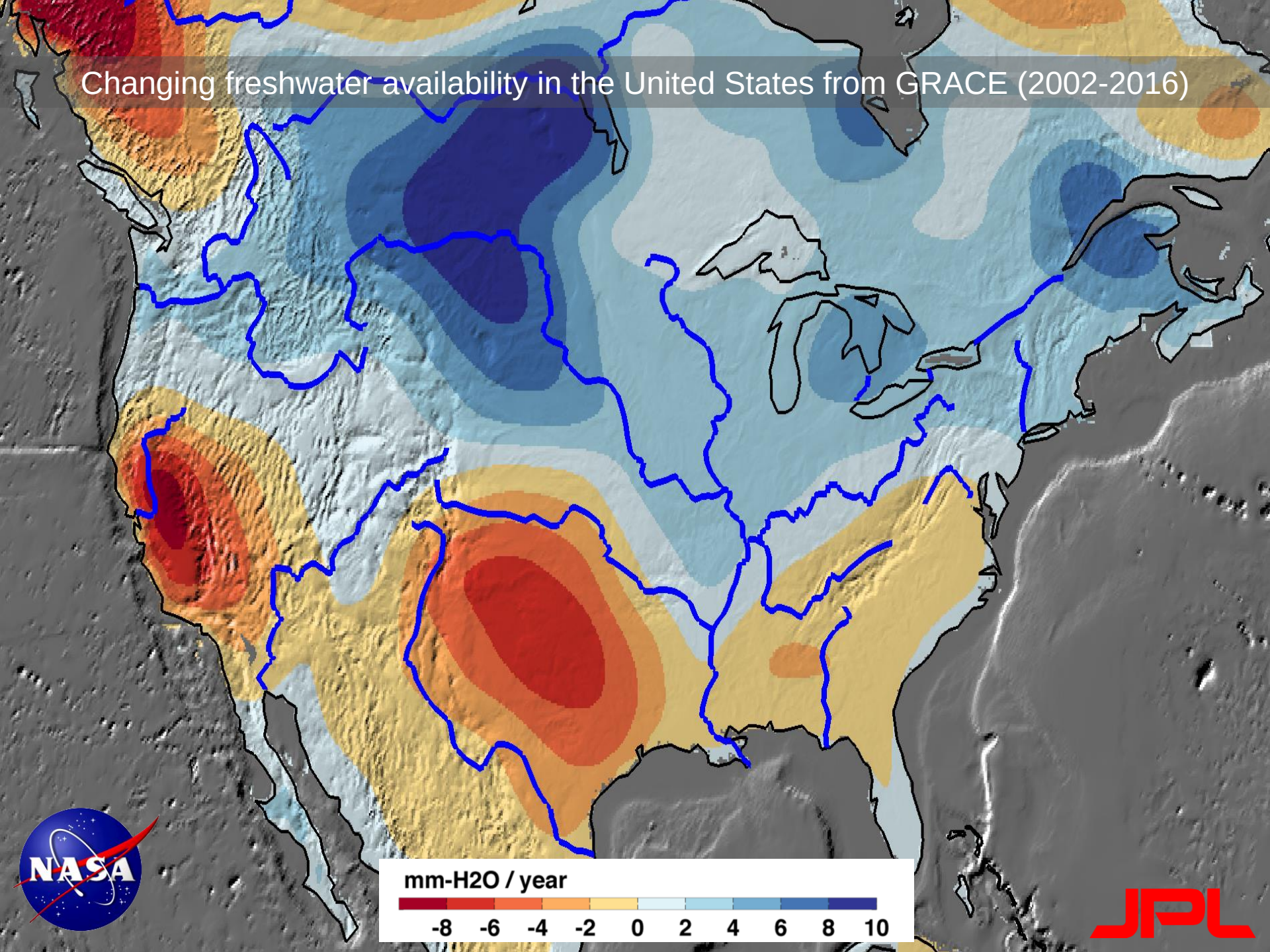
Observation/estimation of:

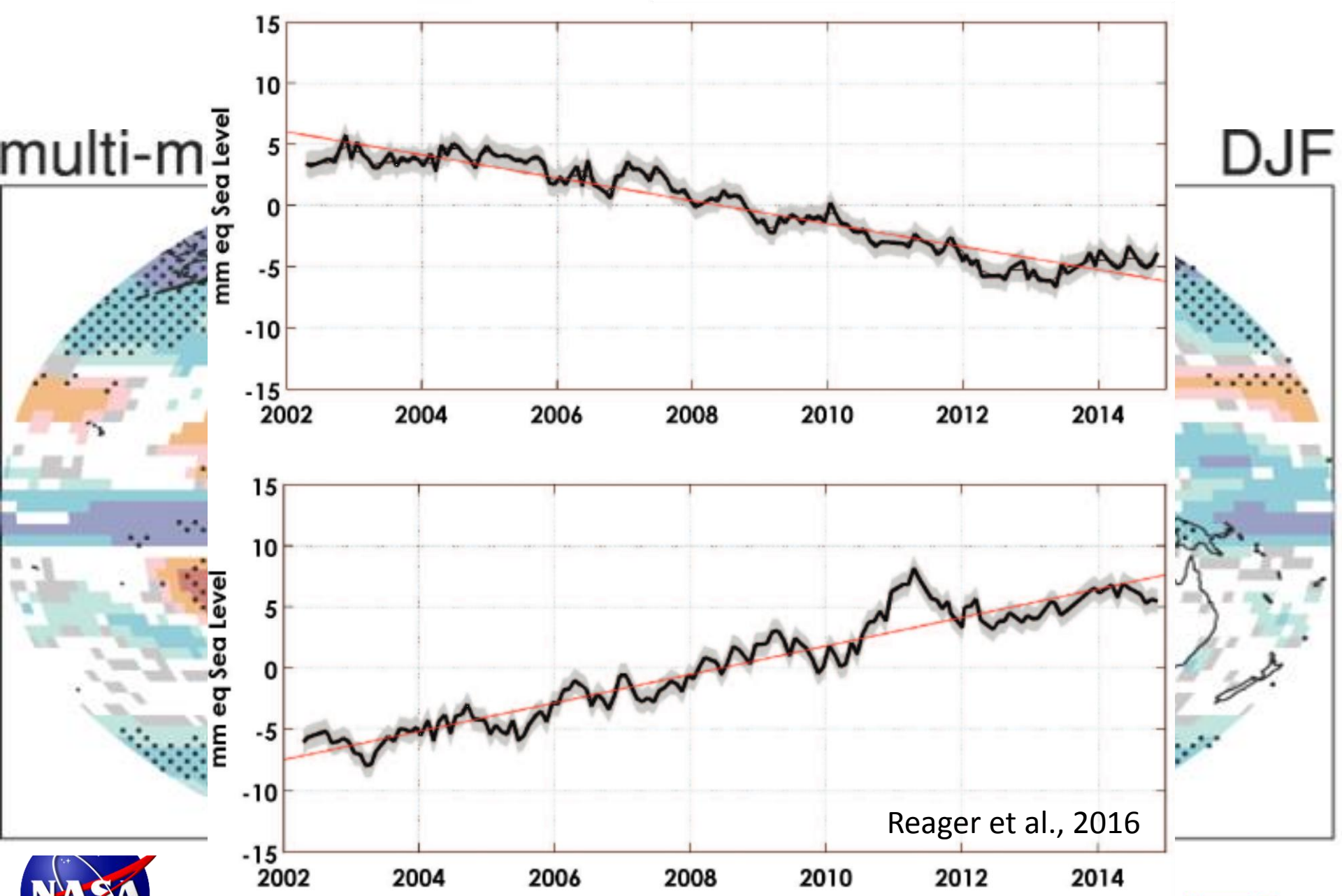
- Precipitation and tracking atmospheric rivers
- Snow cover and snow water equivalent
- Surface water storage in reservoirs, lakes and large rivers
- Surface soil moisture content
- Groundwater storage changes
- Evapotranspiration and fallowed land
- River discharge
- Subsidence
- Flooding and drought



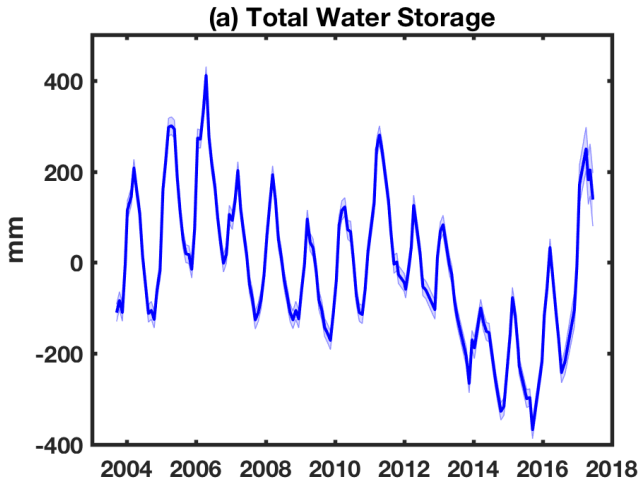

Gravity Recovery and Climate Experiment
(GRACE Mission) 2002-2017

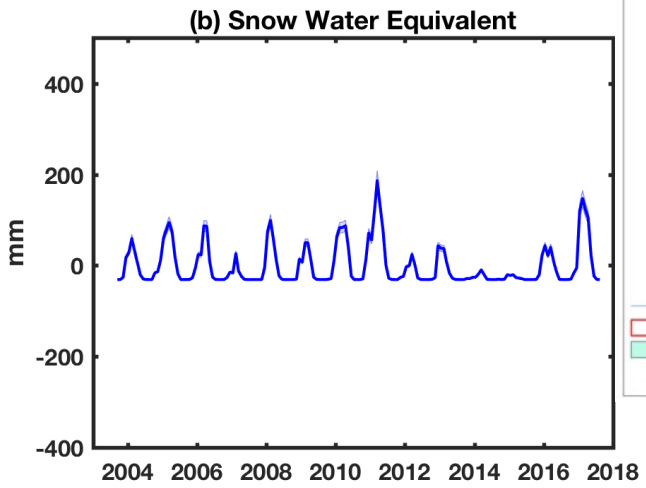
Changing freshwater availability in the United States from GRACE (2002-2016)

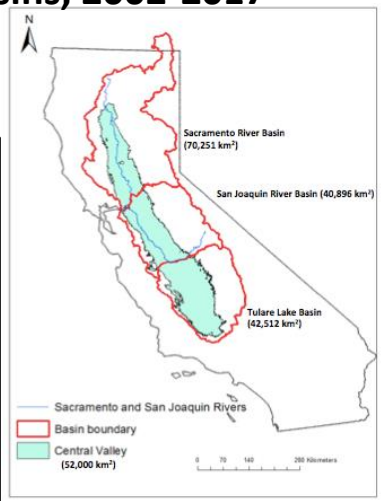


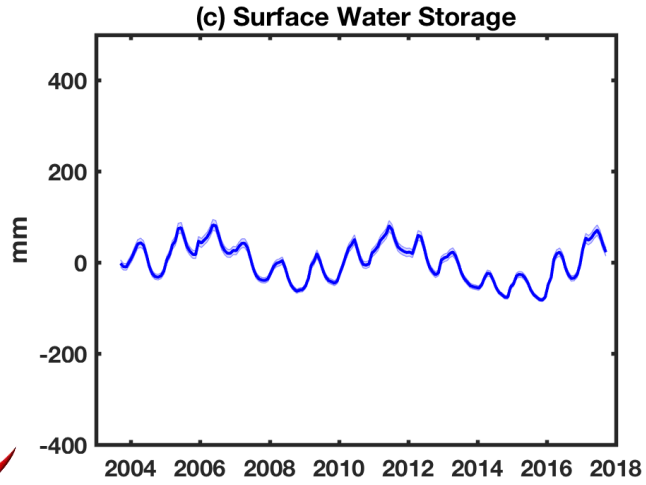

multi-m
DJF
mm eq Sea Level
15
10
5
0
-5
-10
-15
2002
2004
2006
2008
2010
2012
2014
mm eq Sea Level
15
10
5
0
-5
-10
-15
2002
2004
2006
2008
2010
2012
2014
Reager et al., 2016

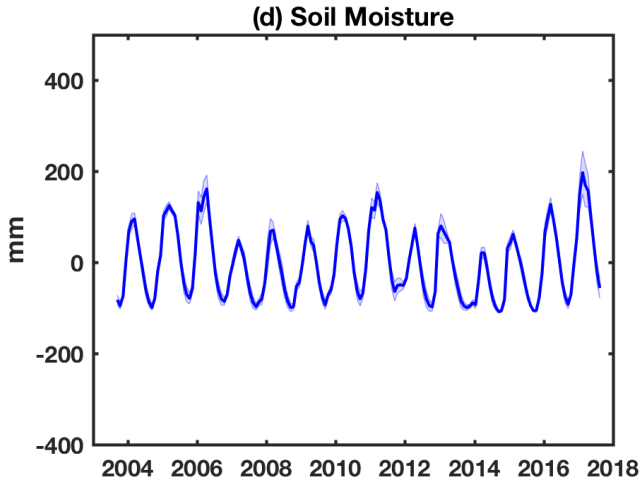
Changes in Total Water Storage in the Sacramento-San Joaquin-Tulare Lake Basins, 2002-2017







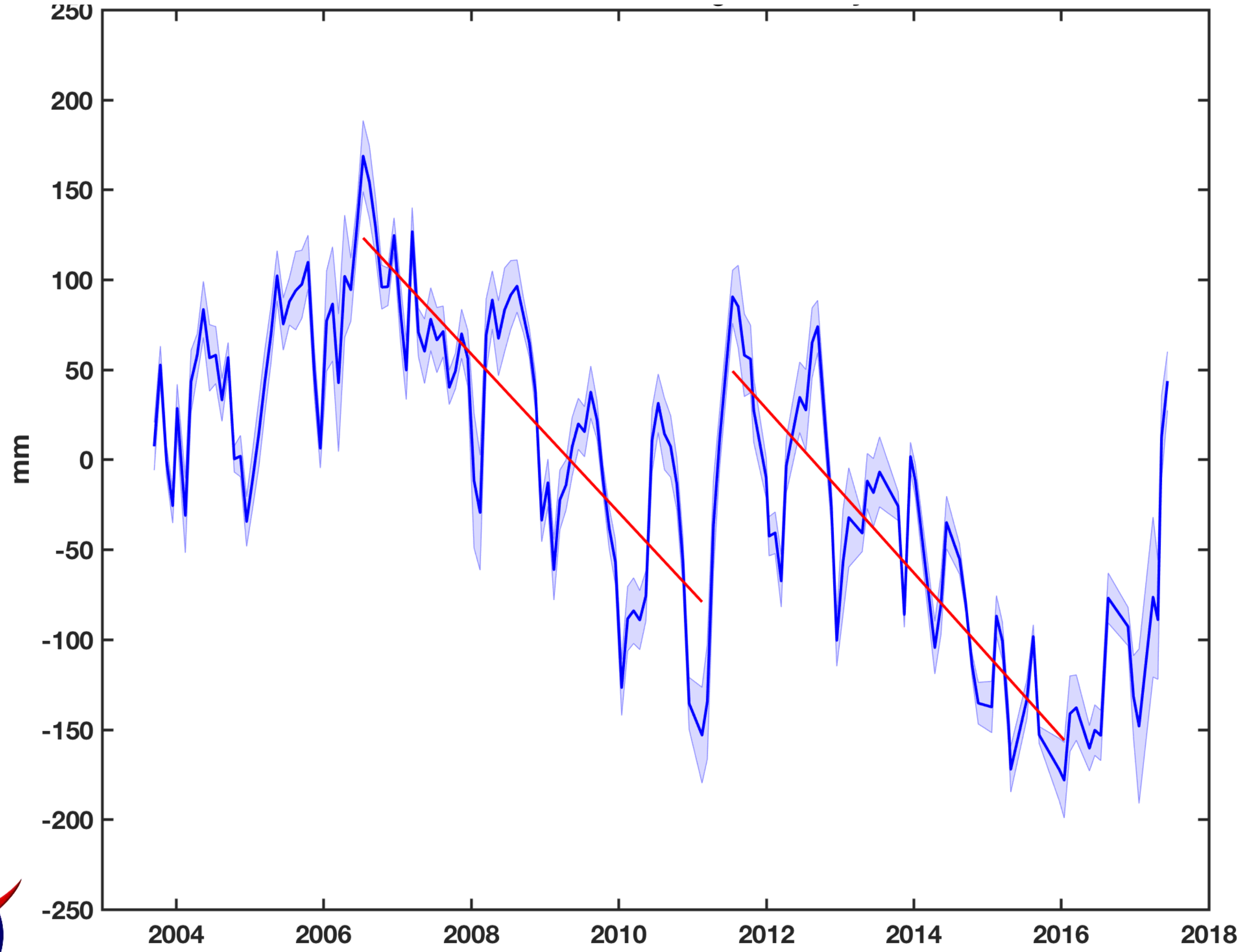


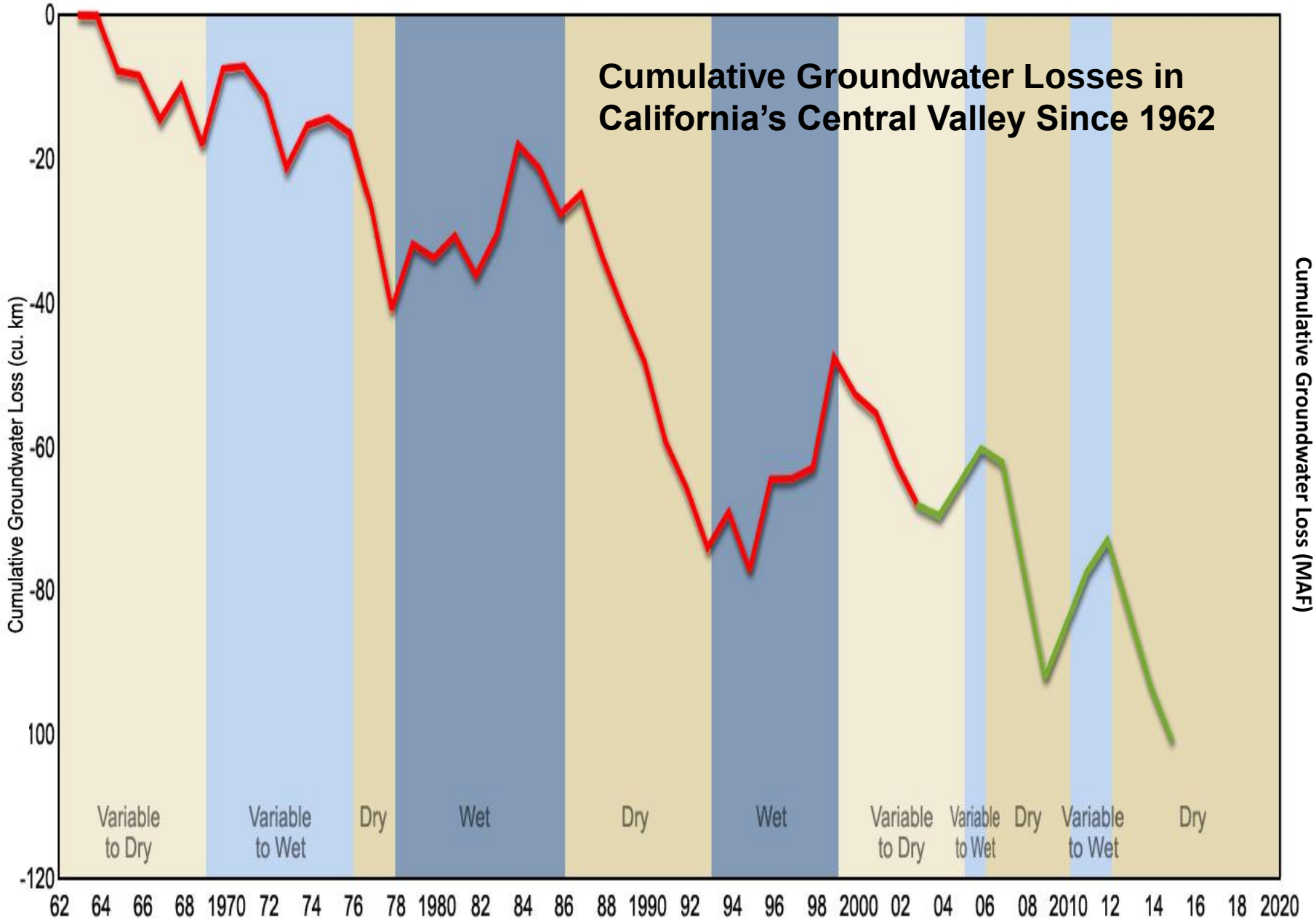


NASA

JPL

Changes in Groundwater Storage in the Central Valley, 2002-2017

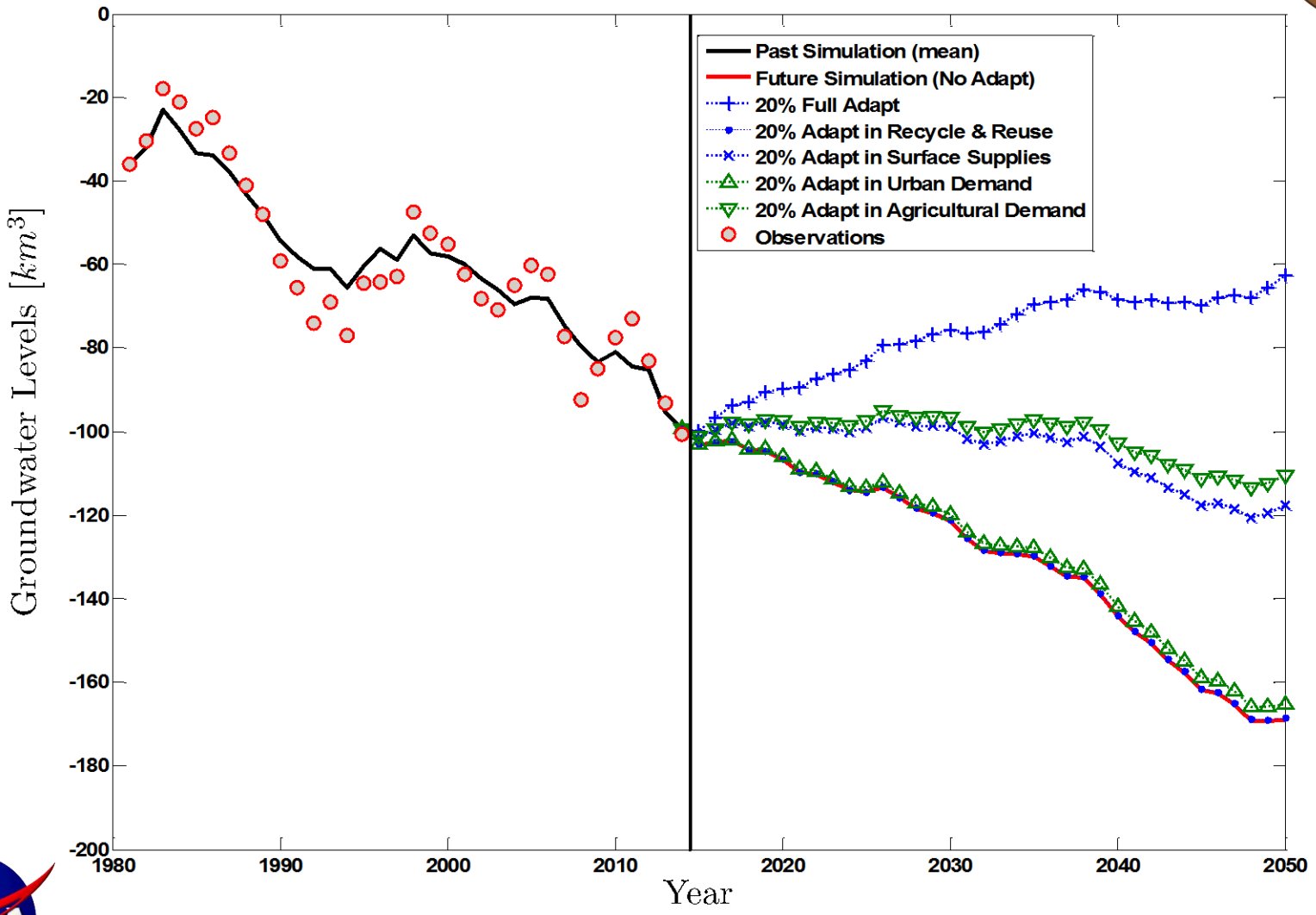



Cumulative Groundwater Losses in California's Central Valley Since 1962
Cumulative Groundwater Loss (cu. km)
Cumulative Groundwater Loss (MAF)
0
-20
-40
-60
-80
100
-120
Variable to Dry
Variable to Wet
Dry
Wet
Dry
Wet
Variable to Dry
Variable to Wet
Dry
Variable to Wet
Dry
62 64 66 68 1970 72 74 76 78 1980 82 84 86 88 1990 92 94 96 98 2000 02 04 06 08 2010 12 14 16 18 2020

Integrated models enable new science and applications

Can we help CA water managers define 'sustainable' groundwater use?

Massoud et al., 2017, in revision

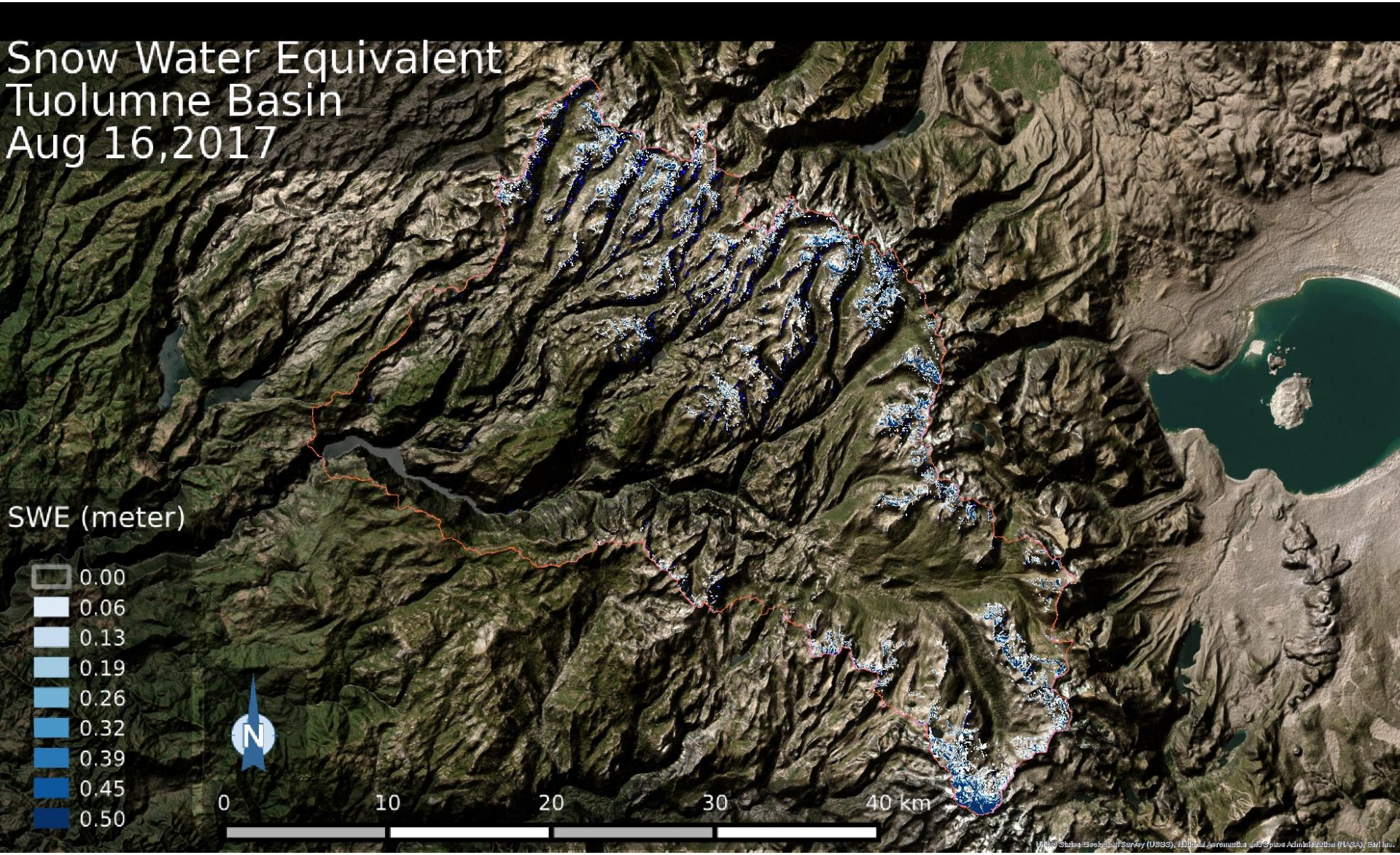


Groundwater Induced Land Subsidence

- Like deflation of a tire
- Only occurs where clay minerals exist
- Currently experiencing fastest rates ever
- Damage to infrastructure: roads, bridges, canals

NASA Airborne Snow Observatory

Photos courtesy of The New York Times


Snow Water Equivalent
Tuolumne Basin
Aug 16,2017
SWE (meter)
0.00
0.06
0.13
0.19
0.26
0.32
0.39
0.45
0.50
N
0
10
20
30
40 km

WWAO – NASA's Western Water Applications Office

A local western office helping to inform water decisions with NASA data

What is the WWAO?

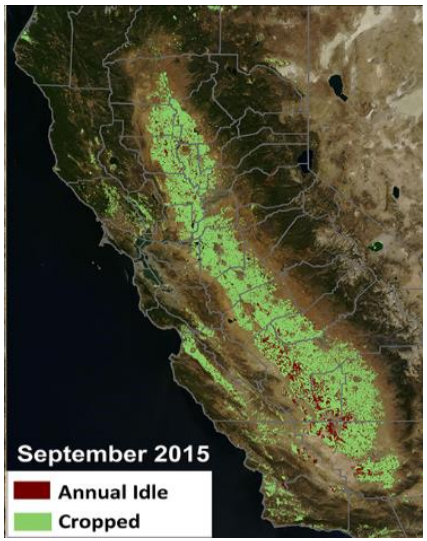
- *A new initiative from NASA's Earth Science Division, Applied Sciences Program to support Western US water management to put NASA data to work in making decisions.*

What does the WWAO do?

- *Connect stakeholders with NASA scientists, technology, tools, and data.*
- *Develop strategic solutions through applications projects.*
- *Assist application transition into operational state.*

Why the NASA-WWAO?

- *Apply NASA's wealth of science, remote sensing data and expertise.*
- *Leverage decades of investment in science and technology.*
- *Develop and maintain lasting relationships with stakeholders.*



Characterizing California Drought with GRACE and Total Water Storage Deficit